FINAL (4TH) SUBMISSION
INCREMENTS A,B,D,E,F,G

# FORT MONMOUTH, NEW JERSEY

EXECUTIVE SUMMARY

# ENERGY ENGINEERING ANALYSIS



prepared for :
U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT

CONTRACT NO. DACA65-81-C-0024

NOVEMBER 1983

SEELYE STEVENSON VALUE & KNECHT
An STV Engineers Professional Firm
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in association with :
M D M Mariano D. Molina P.C.

ENERGY ENGINEERING ANALYSIS PROGRAM

FORT MONMOUTH, NEW JERSEY

# EXECUTIVE SUMMARY

SEELYE STEVENSON VALUE & KNECHT

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STV/SEELYE STEVENSON VALUE & KNECHT.

ENGINEERS & PLANNERS.
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NEW YORK, NY. 10016
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November 28, 1983

Department of the Army
Norfolk District - Corps of Engineers
803 Front Street
Norfolk, VA 23510

Attention of NAOEN-MA/Gerald Barnes

Reference: Energy Engineering Analysis Program (EEAP)
Fort Monmouth, NJ

Subject: Final Submission

Contract No.: DACA65-81-C-0024

Our Log No.: 24-4184-01

Gentlemen:

This letter transmits the Final Submission of the Energy Engineering Analysis for Fort Monmouth, New Jersey. This Submission consists of the following components:

- Executive Summary
- Main Report: Volume 1 of 2 (Buildings, Utilities, Energy Profile)
- Main Report: Volume 2 of 2 (EMCS Feasibility Study)
- Increment F
- Project Programming Documents (Energy Monitoring and Control System)

In addition to being separately bound, the Executive Summary and Increment F are included within the Main Report: Volume 1 of 2.

All comments have been reviewed and incorporated as appropriate.

STV/SEELYE STEVENSON VALUE & KNECHT.

Department of the Army
Norfolk District - Corps of Engineers
Attention of NAOEN-MA/Gerald Barnes



Reference materials including backup calculations, sample survey forms and computer outputs, fuel records and the remaining Project Programming Documents are unchanged from the Prefinal Submission and are included there under the titles of:

| | | |
|---|---|---|
| Appendix | : | Volume 1 of 4 (Sections 1- 8) |
| " | : | Volume 2 of 4 (Section 9) |
| " | : | Volume 3 of 4 (section 9 cont'd.) |
| " | : | Volume 4 of 4 (Sections 10-14) |

| | | |
|---|---|---|
| Project Programming Documents | : | Increment A - Volume 1 of 2 |
| " " " | : | Increment A - Volume 2 of 2 |
| " " " | : | Increment B |
| " " " | : | Increment G |

They are, therefore, not included here. Please refer to them as appropriate.

The assistance that was provided by Fort Monmouth-DEH and the Corps of Engineers personnel proved invaluable in completing this assignment. Their cooperation is greatly appreciated.

Thank you for this opportunity to be of service.

Very truly yours,

STV/Seelye Stevenson Value & Knecht

Alfred Klein, P.E.
Vice President

AK:vbm

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ENERGY ENGINEERING ANALYSIS PROGRAM
FINAL (4TH) SUBMISSION
FORT MONMOUTH, NEW JERSEY

## EXECUTIVE SUMMARY

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November 29, 1983

# 1.0 Introduction

## 1.1 Site Description

### 1.1.1 Location of Site

Fort Monmouth is a U.S. Army Material Development and Readiness Command (DARCOM) installation located in Monmouth County, New Jersey. Surrounding towns include: Oceanport, Eatontown, Long Branch and Little Silver. The installation is located approximately 25 miles south of Newark and 45 miles southwest of New York City. (See Map 3-1, GENERAL AREA MAP.)

### 1.1.2 General Description of Site

The base consists of: the Main Post, the Charles Wood Area which is about 0.5 miles southwest of the Main Post, and the Evans Area, which is about 10 miles south of the Main Post. There are about 610 buildings located on these areas of the Post. Approximately one sixth of the buildings have been surveyed for the purposes of this report.

### 1.1.3 Activities at Fort Monmouth

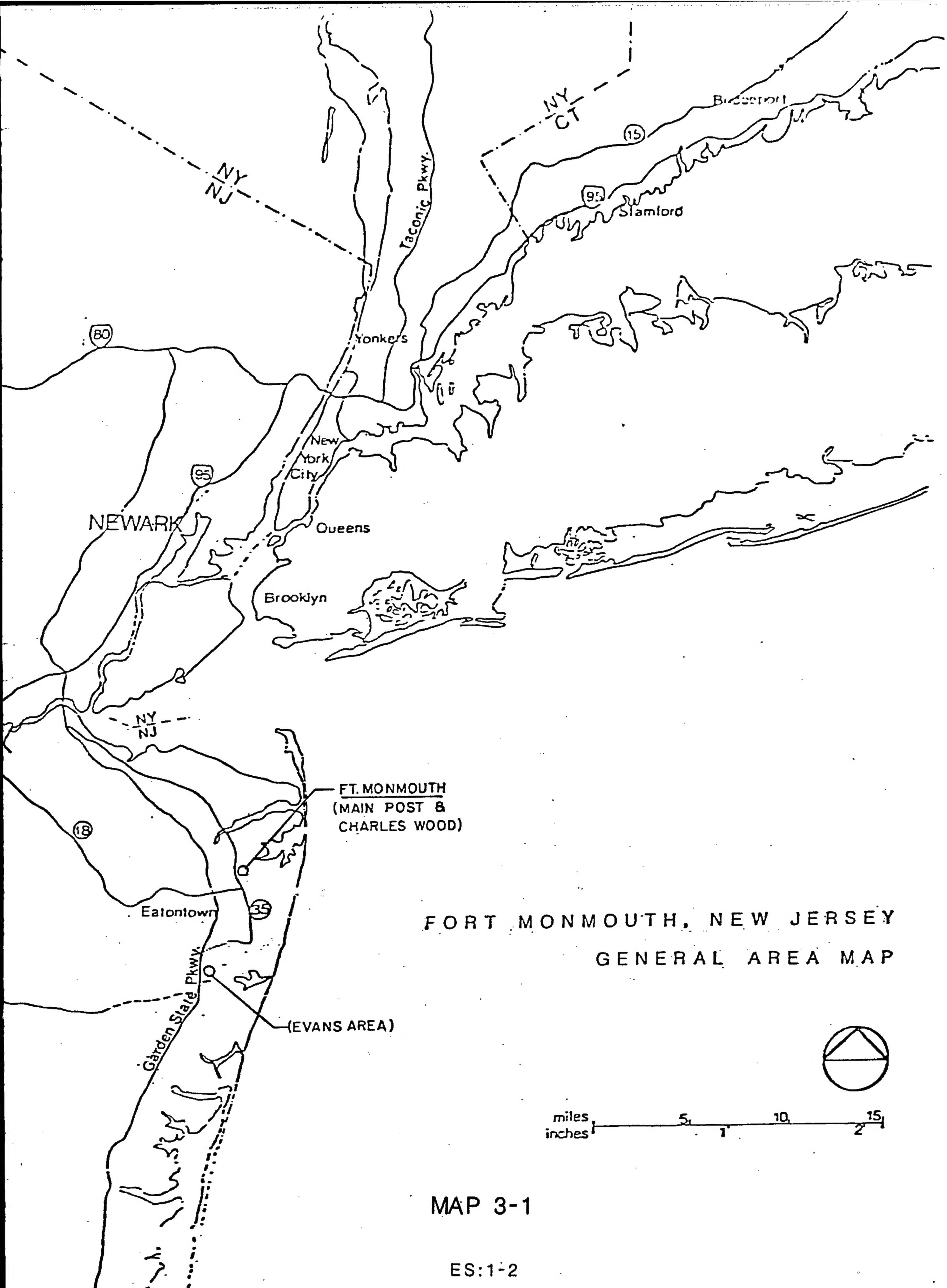
Fort Monmouth provides command, administrative and logistical support for Headquarters, U.S. Army Electronics Command.

Seven major activities are located at or near Fort Monmouth; they are: the Army Electronics Command (ECOM), the US Military Academy Preparatory School, the Army Communications Systems Agency, the Joint Tactical Communications Office (TRI-TAC), the Army Satellite Communications Agency, the Army Communications Command Agency, and the Health Services Command, Medical Department Activities, Paterson Army Hospital.

The ECOM mission is to exercise the life-cycle management of Army electronics, encompassing research, development, procurement, production engineering, industrial mobilization planning, and new equipment training. The command's principle interests are in military radio communications, automatic data processing, combat surveillance, radar, infra-red, maser and lasers, avionics, television, electronic warfare, and both ground and aerial photography.

### 1.1.4 History

The activation of Fort Monmouth started at the beginning of World War I when the Signal Corps had a requirement for a training center on the eastern seaboard near transportation and preferably near a large port of embarkation. The site leased (468 acres) was a tract of land used by the old Monmouth Park Race Track.




FORT MONMOUTH, NEW JERSEY

GENERAL AREA MAP

MAP 3-1

Fort Monmouth was authorized as an army installation by the Adjutant General in May 1917. The land was purchased during the years 1919 to 1923.

In 1927 construction of permanent buildings was started. Sidewalks and roads were paved and a street lighting system was installed.

In 1939 when circumstances in Europe caused a state of "limited emergency," all Signal Corps functions faced the most urgent evolution in their history. Hundreds of mobiliation-type buildings, barracks, and other structures were built to house expanding activities and facilities. Expansion continued through World War II, the Korean War, and during the Vietnam war.

## 1.2 Purpose of Study

The purpose of this analysis is to develop a systematic program of projects that will result in energy consumption reductions in compliance with the stated goals of the Army Facilities Energy Plan.

A. Reduce Army installation and active energy consumption by 25% of that consumed in FY75 as the base year.

B. Reduce average annual energy consumption per gross square foot of floor area by 20% in existing facilities compared to FY75 as the base year. At least 12% of the energy consumption reduced in existing buildings shall be accomplished through energy conservation projects under the Energy Conservation Investment Program (ECIP).

C. Reduce average annual energy consumption per gross square foot of floor area by 45% in new buildings compared to FY75 as the base year.

D. Reduce dependence on critical fuels. The DOD goals to reduce dependence on critical fuels are:

(1) To obtain at least 10% of total Army installation energy from coal, coal gasification, solid waste, refuse derived fuel and biomass.

(2) To equip all natural gas only heating units and plants over 5 MEGA BTU per hour output with the capability to use oil or other alternate fuels (1982 goal).

(3) To have on hand at the beginning of each heating season a 30-day fuel supply for all oil only, oil - natural gas, and coal heating units over 5 mega BTU per hour output based upon the coldest month recorded and in a mobilization condition.

In order to achieve these goals, the following will be incorporated:

- applicable data and results of related past and current studies
- a coordinated Energy Engineering Analysis of the base
- Project Development Brochures (PDB's), Military Construction Project Data (DD Forms 1391), and supporting documentation for feasible Energy Conservation Investment Program (ECIP) projects
- practical and economically feasible energy conservation methods
- a listing of recommended ECIP projects in SIR order

## 1.3 Authority for Study

This Energy Engineering Analysis was undertaken and this Report was prepared under Contract No. DACA65-81-C-0024 issued by the Department of the Army, Norfolk Disrict, Corps of Engineers, to Seelye Stevenson Value & Knecht.

## 1.4 Scope of Work

The scope of work for this Energy Engineering Analysis is defined in "DAEN-MPE-E SCOPE OF WORK FOR ENERGY ENGINEERING ANALYSIS PROGRAM" dated January 22, 1982. This document has been reporduced and is in the Appendix Volume 1, Section 4.

Economic analyses are performed in accordance with "DAEN-MPO-U ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) GUIDANCE" dated August 10, 1982.

## 1.5 Increments of Work

### 1.5.1 Increment A

Increment A projects involve modifying, improving or retrofitting existing buildings. These projects typically involve architectural and structural features, HVAC systems, plumbing systems, interior and exterior building lighting and parking facilities lighting.

### 1.5.2 Increment B

Increment B projects involve utilities and energy distribution systems, EMCS for building and distirbuition systems, and existing energy plants. Energy distribution systems include steam, chilled water and hot water distribution as well as pumps, wells, storage and treatment facilities.

1.5.3 Increment C

Increment C projects involve renewable energy sources such as solar, boimass, hydro, wind, tide, wave propogation, geothermal and nuclear energy. Renewable energy projects include space heating, space cooling, domestic hot water, process heat, or combinations thereof.

1.5.4 Increment D

Increment D projects involve determining the feasibility of new co generation and solid waste plants utilizing solid fuels supplemented, if feasible, with refuse derived fuels (RDF) and waste oil fuels. The primary objective is to reduce energy consumption through the capture and reuse of energy presently being wasted.

1.5.5 Increment E

Increment E projects involve determining the feasibility of constructing central boiler plants to supply steam or high temperature hot water, as applicable, to all or discrete parts of the base.

1.5.6 Increment F

Increment F projects involve recommending modifications and changes in system operation which are within the Facilities Engineer funding authority and management control. Other areas under Increment F include determining any energy-related areas of operation requiring additional training of Facilities Engineering personnel and describing expendable equipment which should be changed to a higher efficiency type at its next replacement.

1.5.7 Increment G

Increment G projects are those feasible energy savings projects developed in Increments A and B which do not qualify under ECIP criteria.

## 2.0 Historical Energy Consumption

### 2.1 Energy Sources

Energy sources used at Fort Monmouth include No. 2 fuel oil, No. 6 fuel oil, natural gas and electricity.

No. 2 and No. 6 fuel oil are used to generate steam and hot water in boiler plants. Steam and hot water are used for space heating, boiler room auxiliaries and some domestic hot water.

Natural gas is used for heating, laboratory work, cooking in family housing and domestic hot water generation.

Electricity is used for lighting; motors for fans, pumps and air conditioning compressors; domestic hot water and various types of machinery.

### 2.2 Historical Energy Consumption Profile

The historical energy consumption profile is based on data from FY75 through FY82. Fuel records obtained from Fort Monmouth personnel are in the Appendix - Volume 4, Section 12. Data from the fuel records is summarized and tabulated in the Appendix - Volume 4, Section 11.

#### 2:2.1 Tabular Information

Table 2-1 entitled "ANNUAL ENERGY CONSUMPTION" shows annual energy use from FY75 through FY82 for total source energy, No. 2 and No. 6 fuel oil, natural gas and electricity (both kWH consumption and kW demand.)

Table 2-1 indicates the following information for each fuel:

- Base Unit Consumption - Base units for the individual energy sources are as follows:

  Fuel Oil - GAL/YR
  Natural Gas - CCF/YR
  Electricity - KWH/YR

- Consumption in MBTU/YR
- Unit Consumption in KBTU/GSF-YR
- Unit Consumption per Degree Day
- Energy Index, Ref FY75 - Ratio of unit consumption in any year to the base year FY75. The value of the base year is 100.
- Cost in Dollars per Year.
- Unit Cost in Dollars/1000 GSF-YR.
- Cost Index, Ref FY75 - Analogus to Energy Index.
- DARCOM Goal - The DARCOM Goal is defined in terms of total source energy and is not listed for individual fuels.

TABLE 2-1

ANNUAL ENERGY CONSUMPTION FY75 TO FY82

FORT MONMOUTH, NEW JERSEY

| PARAMETER | UNITS | FY75 | FY76 | FY77 | FY78 | FY79 | FY80 | FY81 | FY82 |
|---|---|---|---|---|---|---|---|---|---|
| Gross Floor Area | GSF | 7,254,666 | 7,223,511 | 7,308,701 | 7,123,225 | 7,123,261 | 6,395,125 | 6,392,401 | 6,392,401 |
| Heating Degree Days | DD | 4,659 | 4,406 | 5,404 | 5,313 | 4,669 | 4,553 | 5,111 | 5,114 |
| TOTAL SOURCE ENERGY: | | | | | | | | | |
| Consumption | MBTU/YR | 1,884,380 | 1,800,557 | 1,555,705 | 1,524,431 | 1,464,751 | 1,397,190 | 1,360,241 | 1,423,804 |
| Unit Consumption | KBTU/GSF/YR. | 259 | 249 | 213 | 214 | 206 | 218 | 213 | 223 |
| Darcom Goal | KBTU/GSF/YR | 259 | 253 | 248 | 243 | 238 | 233 | 227 | 223 |
| Unit Consumpton/DD | BTU/GSF/DD/YR | 55 | 57 | 39 | 40 | 44 | 48 | 42 | 44 |
| Energy Index, Ref. FY75 | | 100 | 96 | 82 | 83 | 80 | 84 | 82 | 86 |
| Energy Cost | DOLLARS/YR | 4,078,658 | 4,108,813 | 4,275,176 | 4,238,868 | 4,768,862 | 7,391,981 | 8,744,547± | * |
| Unit Energy Cost | DOLLARS/KGSF/YR | 562 | 569 | 585 | 595 | 669 | 1,156 | 1,368 | * |
| Energy Cost Index, Ref. FY75 | | 100 | 101 | 104 | 106 | 119 | 206 | 243 | * |
| NO. 2 FUEL OIL: CONSUMPTION | GAL/YR | 4,060,497 | 4,022,264 | 3,542,769 | 3,452,401 | 3,354,052 | 2,879,185 | 2,876,424 | 3,023,468 |
| Consumption | MBTU/YR | 563,191 | 557,888 | 491,382 | 478,848 | 465,207 | 399,343 | 398,960 | 419,355 |
| Unit Consumption | KBTU/GSF/YR | 78 | 77 | 67 | 67 | 65 | 62 | 62 | 66 |
| Unit Consumption/DD | BTU/GSF/DD/YR | 17 | 18 | 12 | 13 | 14 | 14 | 12 | 13 |
| Energy Index, Ref. FY75 | | 100 | 99 | 86 | 86 | 83 | 79 | 79 | 85 |
| Energy Cost | DOLLARS/YR | 1,257,270 | 1,301,888 | 1,337,697 | 1,442,057 | 1,642,499 | 2,869,424 | 3,509,240 | * |
| Unit Energy Cost | DOLLARS/KGSF/YR | 173 | 180 | 183 | 202 | 231 | 449 | 549 | * |
| Energy Cost Index, Ref. FY75 | | 100 | 104 | 106 | 117 | 134 | 260 | 317 | * |
| NO. 6 FUEL OIL: CONSUMPTION | GAL/YR | 2,488,694 | 2,465,257 | 2,171,368 | 2,106,194 | 2,055,708 | 1,893,063 | 1,639,306 | 1,795,868 |
| Consumption | MBTU/YR | 358,372 | 354,997 | 312,677 | 303,292 | 296,022 | 272,601 | 236,060 | 251,405 |
| Unit Consumption | KBTU/GSF/YR | 49 | 49 | 43 | 43 | 42 | 43 | 37 | 39 |
| Unit Consumption/DD | BTU/GSF/DD/YR | 11 | 11 | 8 | 8 | 9 | 9 | 7 | 8 |
| Energy Index, Ref. FY75 | | 100 | 100 | 88 | 88 | 86 | 88 | 76 | 80 |
| Energy Cost | DOLLARS/YR | 803,828 | 832,354 | 860,344 | 708,134 | 982,677 | 1,451,788 | 1,426,198 | * |
| Unit Energy Cost | DOLLARS/KGSF/YR | 111 | 115 | 118 | 99 | 138 | 227 | 223 | * |
| Energy Cost Index, Ref. FY75 | | 100 | 104 | 106 | 89 | 124 | 205 | 201 | * |

TABLE 2-1

ANNUAL ENERGY CONSUMPTION FY75 TO FY82 - (cont'd.)

FORT MONMOUTH, NEW JERSEY

| | UNITS | FY75 | FY76 | FY77 | FY78 | FY79 | FY80 | FY81 | FY82 |
|---|---|---|---|---|---|---|---|---|---|
| NATURAL GAS: CONSUMPTION | CCF/YR | 1,262,861 | 1,125,955 | 1,102,735 | 1,024,830 | 972,609 | 979,117 | 988,197 | 1,004,937 |
| Consumption | MBTU/YR | 139,201 | 116,086 | 113,692 | 105,660 | 100,276 | 100,947 | 101,883 | 103,609 |
| Unit Consumption | KBTU/GSF/YR | 18 | 16 | 16 | 16 | 14 | 16 | 16 | 16 |
| Unit Consumption/DD | BTU/GSF/DD/YR | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| Energy Index, Ref. FY75 | | 100 | 89 | 89 | 83 | 78 | 89 | 89 | 89 |
| Energy Cost | DOLLARS/YR | 233,660 | 221,899 | 284,023 | 230,984 | 261,723 | 323,746 | 448,585 | * |
| Unit Energy Cost | DOLLARS/KGSF/YR | 32 | 31 | 39 | 32 | 37 | 51 | 70 | * |
| Energy Cost Index, Ref. FY75 | | 100 | 97 | 122 | 100 | 116 | 159 | 219 | * |
| ELECTRICITY: CONSUMPTION | KWH/YR | 71,003,966 | 66,516,034 | 54,996,034 | 54,881,983 | 52,003,966 | 53,818,966 | 53,736,034 | 55,985,750 |
| Consumption | MBTU/YR | 823,616 | 771,586 | 637,954 | 636,631 | 603,246 | 624,300 | 623,338 | 649,435 |
| Unit Consumption | KBTU/GSF/YR | 114 | 107 | 87 | 89 | 85 | 98 | | 102 |
| Unit Consumption/DD | BTU/GSF/DD/YR | 24 | 24 | 16 | 17 | 18 | 21 | 19 | 20 |
| Energy Index, Ref. FY75 | | 100 | 94 | 76 | 78 | 75 | 86 | 86 | 89 |
| Energy Cost | DOLLARS/YR | 1,783,900 | 1,752,672 | 1,793,112 | 1,857,693 | 1,881,963 | 2,747,023 | 3,360,524 | * |
| Unit Energy Cost | DOLLARS/KGSF/YR | 246 | 243 | 245 | 261 | 264 | 430 | 526 | * |
| Energy Cost Index, Ref. FY75 | | 100 | 99 | 100 | 106 | 107 | 175 | 214 | * |
| DEMAND | KW/YR | * | * | * | * | * | * | 124,872 | * |

* -- DATA NOT AVAILABLE

### 2.2.2 Graphic Information

Figure 2-1 shows total source energy consumption from FY75 through FY82. During this period total source energy consumption is declining. This decline can be attributed to the following factors:

- o Demolition of Buildings
- o Reduction is Military Personnel
- o Energy Conservation

Figures 2-2, 2-3, 2-4 and 2-5 show month by month MBTU consumption of total source energy, No. 2 and No. 6 fuel oil, natural gas and electricity for FY 75, 79, 80 and 81, respectively. These years represent the last three available years and the base year. Yearly energy data for FY 82 was available and is so indicated in Table 2-1. Month by month breakdowns for FY 82 were not available at the time this report was prepared.

The following information can be seen in Figures 2-2 through 2-5: Total source energy, both yearly consumption and peak monthly value, is declining. No. 2 fuel oil is the most dominant energy source in the winter and electricity is the most dominant fuel in the summer (this is to be expected due to heating from No. 2 oil and cooling from electricity). Natural gas consumption is relatively constant and makes up a small percentage of the total source energy picture.

Monthly electric demand for FY 81, plotted in Figure 2-6, varied from a minimum of 8,848 KW in October to a maximum of 13, 868 KW in July. The periods of minimum and maximum electric energy consumption coincide with the periods of minimum and maximum electric demand. Individual components of electric demand are summarized below in Table 2-2.

TABLE 2-2

INDIVIDUAL COMPONENTS OF ELECTRIC DEMAND

| MONTH | MAIN POST | CHARLES WOOD | EVANS | TOTAL-KW |
|---|---|---|---|---|
| OCT 80 | 4,488 | 3,920 | 440 | 8,848 |
| NOV 80 | 4,500 | 3,940 | 420 | 8,860 |
| DEC 80 | 4,620 | 3,780 | 500 | 8,900 |
| JAN 81 | 4,764 | 3,780 | 440 | 8,984 |
| FEB 81 | 4,752 | 3,940 | 392 | 9,084 |
| MAR 81 | 4,632 | 3,720 | 420 | 8,772 |
| APR 81 | 4,338 | 3,640 | 422 | 8,400 |
| MAY 81 | 5,076 | 4,580 | 642 | 10,298 |
| JUN 81 | 6,858 | 5,540 | 820 | 13,218 |
| JUL 81 | 7,242 | 5,720 | 906 | 13,868 |
| AUG 81 | 7,182 | 5,660 | 894 | 13,736 |
| SEP 81 | 6,456 | 4,660 | 788 | 11,904 |

For any one month in FY 81, the components of electric demand are approximately as follows:

| | | |
|---|---|---|
| o | Main Post | 50% of demand |
| o | Charles Wood | 45% of demand |
| o | Evans | 5% of demand |

Figure 2-7 indicates how electric demand varies over a typical weekday in March, 1983. The profile indicates major elctric use occurs between 8 A.M. and 5 P.M. This is to be expected at Fort Monmouth since there are many administrtion buildings which are occupied weekdays from 8 A.M. to 5 P.M.

FIGURE 2-1

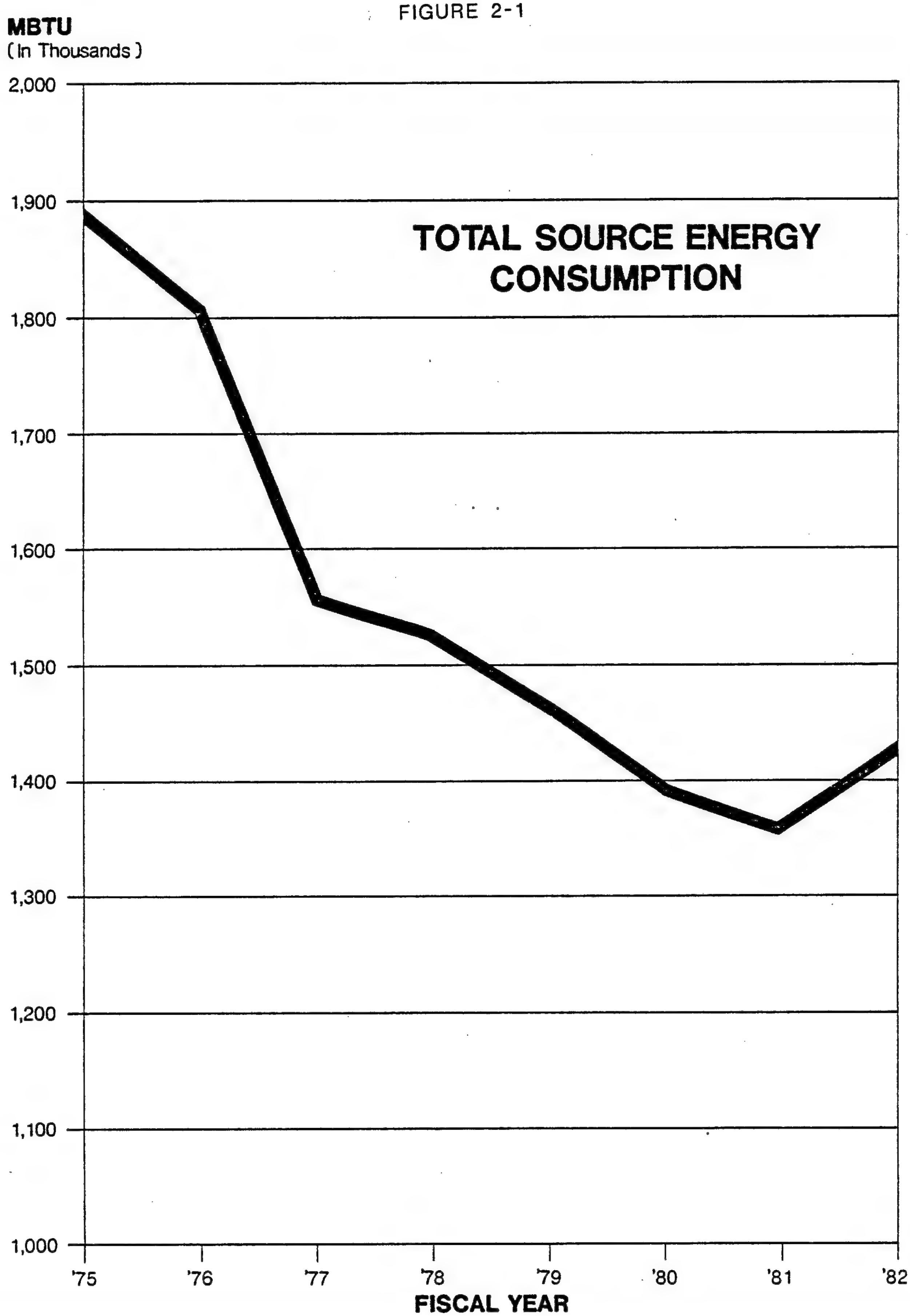

MBTU
(In Thousands)
2,000
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
TOTAL SOURCE ENERGY CONSUMPTION
'75
'76
'77
'78
'79
'80
'81
'82
FISCAL YEAR

FIGURE 2-2

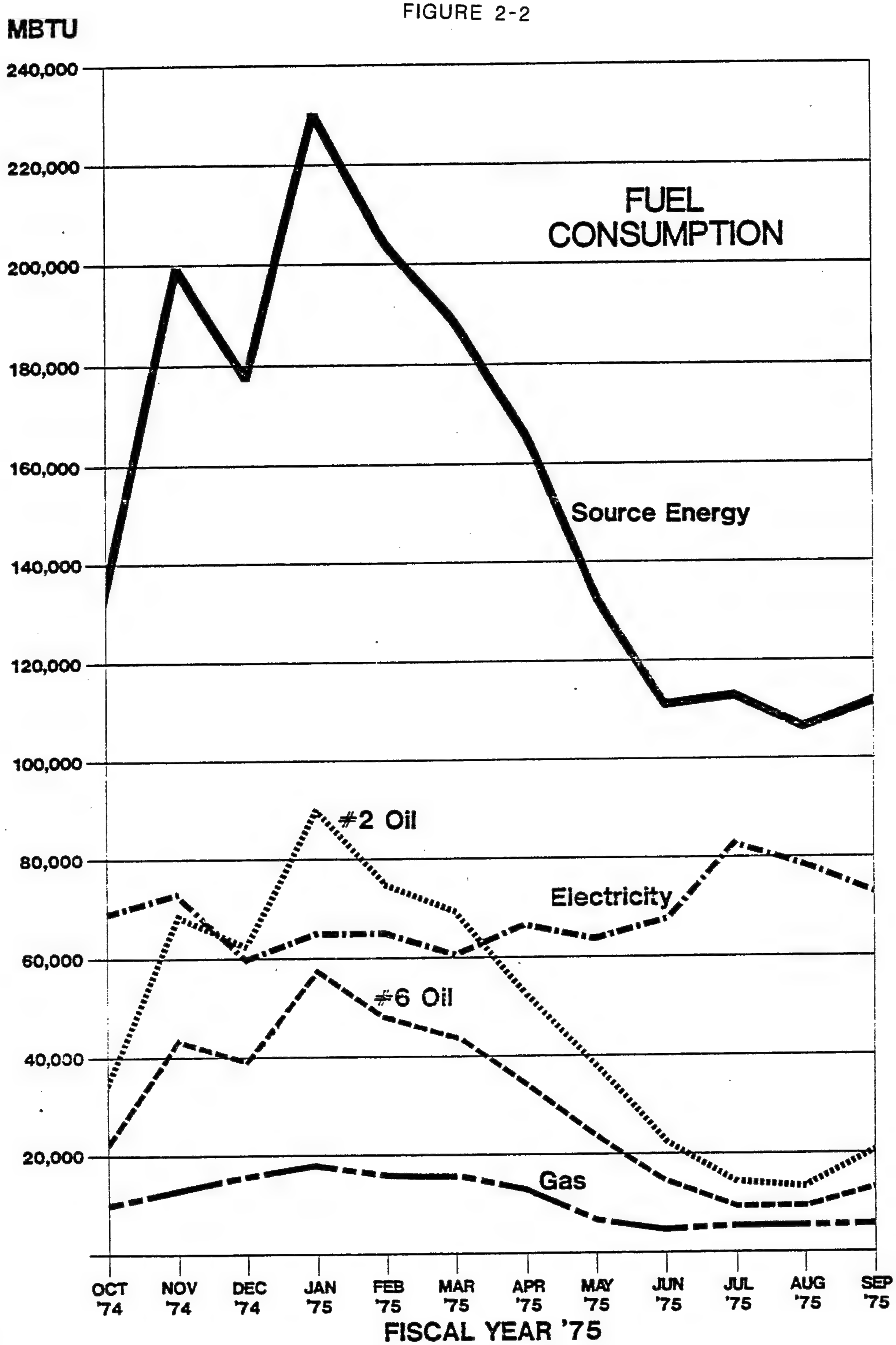

MBTU
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
FUEL CONSUMPTION
Source Energy
#2 Oil
Electricity
#6 Oil
Gas
OCT '74
NOV '74
DEC '74
JAN '75
FEB '75
MAR '75
APR '75
MAY '75
JUN '75
JUL '75
AUG '75
SEP '75
FISCAL YEAR '75

FIGURE 2-3

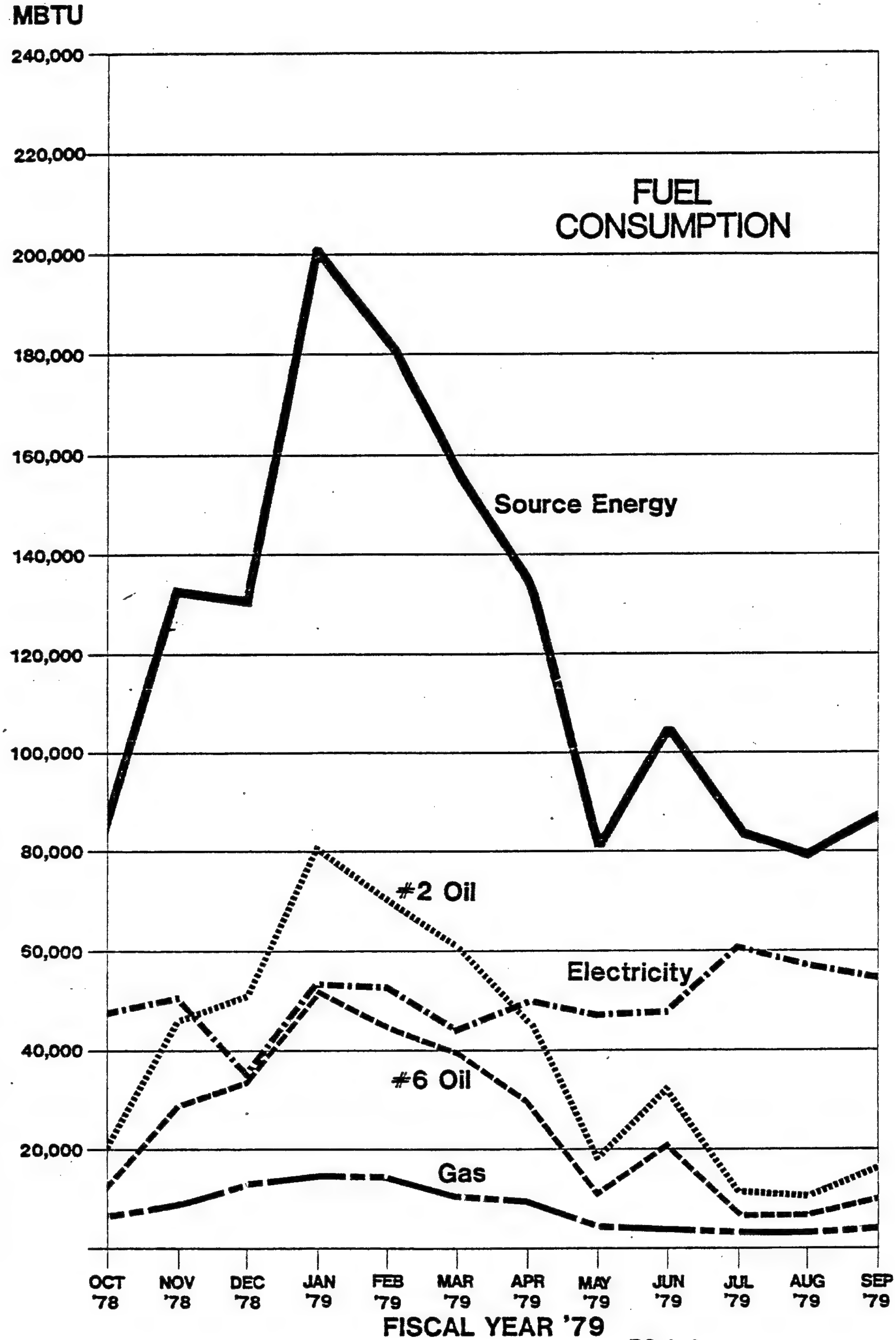

MBTU
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
FUEL CONSUMPTION
Source Energy
#2 Oil
Electricity
#6 Oil
Gas
OCT '78
NOV '78
DEC '78
JAN '79
FEB '79
MAR '79
APR '79
MAY '79
JUN '79
JUL '79
AUG '79
SEP '79
FISCAL YEAR '79

FIGURE 2-4

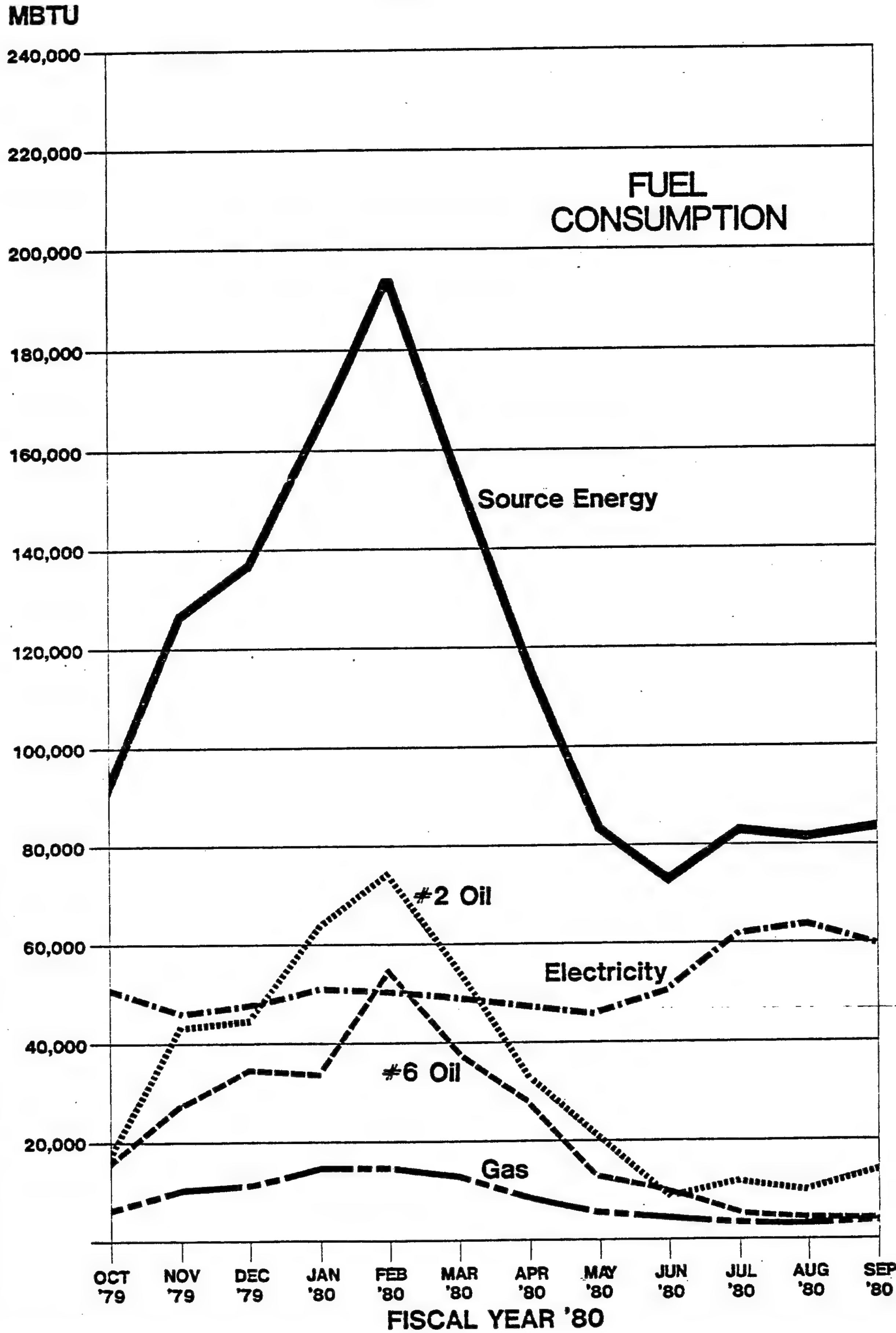

MBTU
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
FUEL CONSUMPTION
Source Energy
#2 Oil
Electricity
#6 Oil
Gas
OCT '79
NOV '79
DEC '79
JAN '80
FEB '80
MAR '80
APR '80
MAY '80
JUN '80
JUL '80
AUG '80
SEP '80
FISCAL YEAR '80

FIGURE 2-5

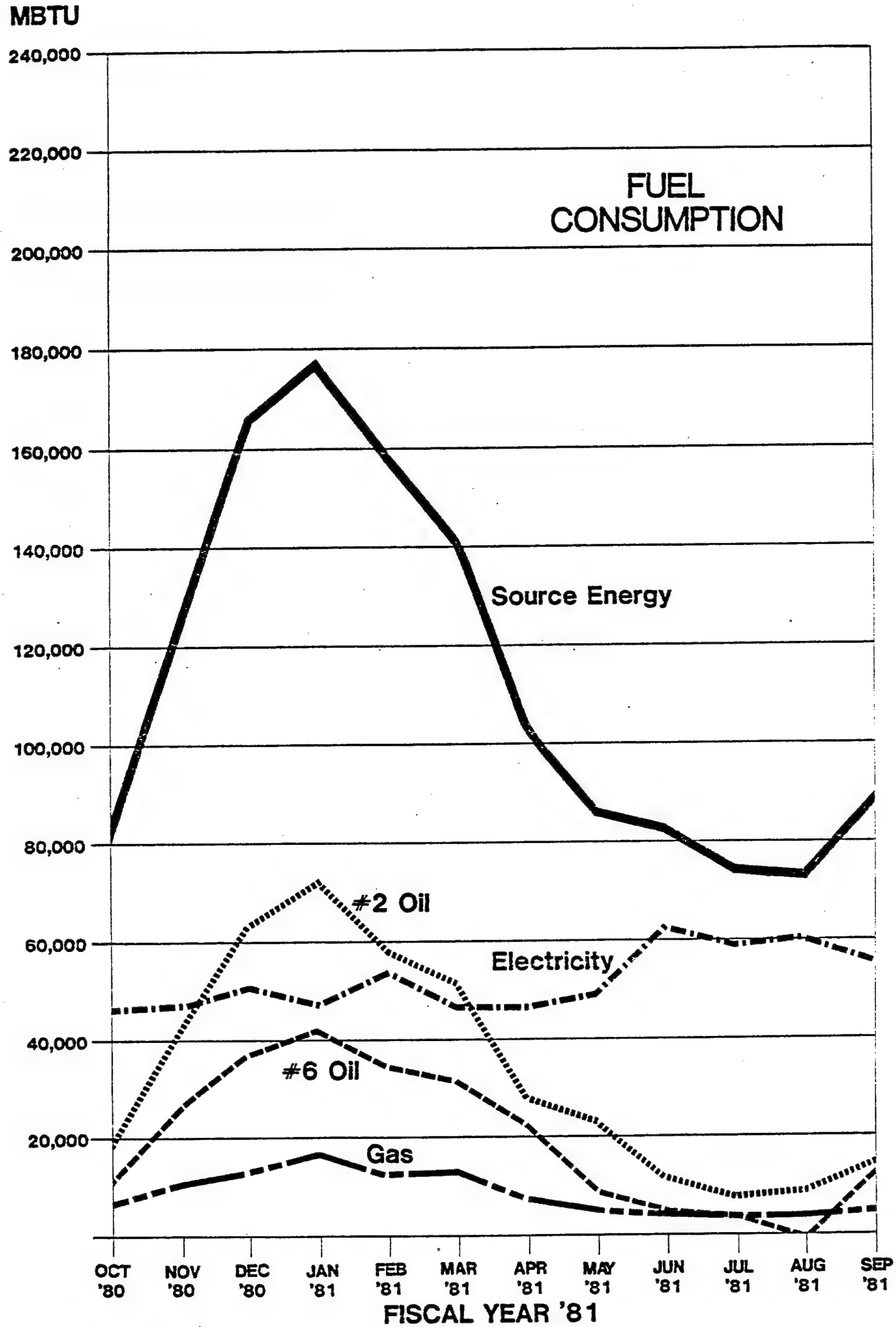

MBTU
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
FUEL
CONSUMPTION
Source Energy
#2 Oil
Electricity
#6 Oil
Gas
OCT '80
NOV '80
DEC '80
JAN '81
FEB '81
MAR '81
APR '81
MAY '81
JUN '81
JUL '81
AUG '81
SEP '81
FISCAL YEAR '81

FIGURE 2-6

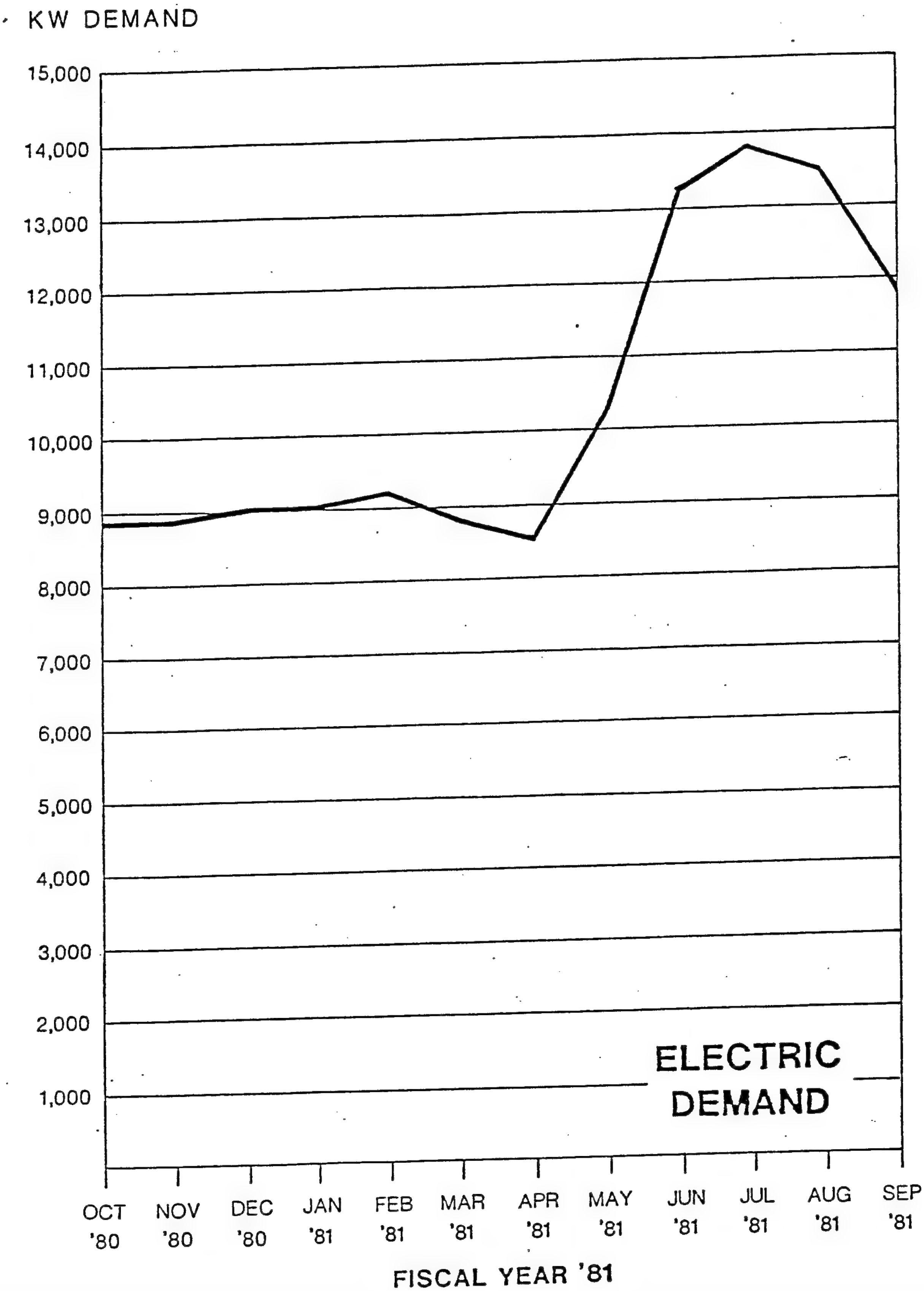
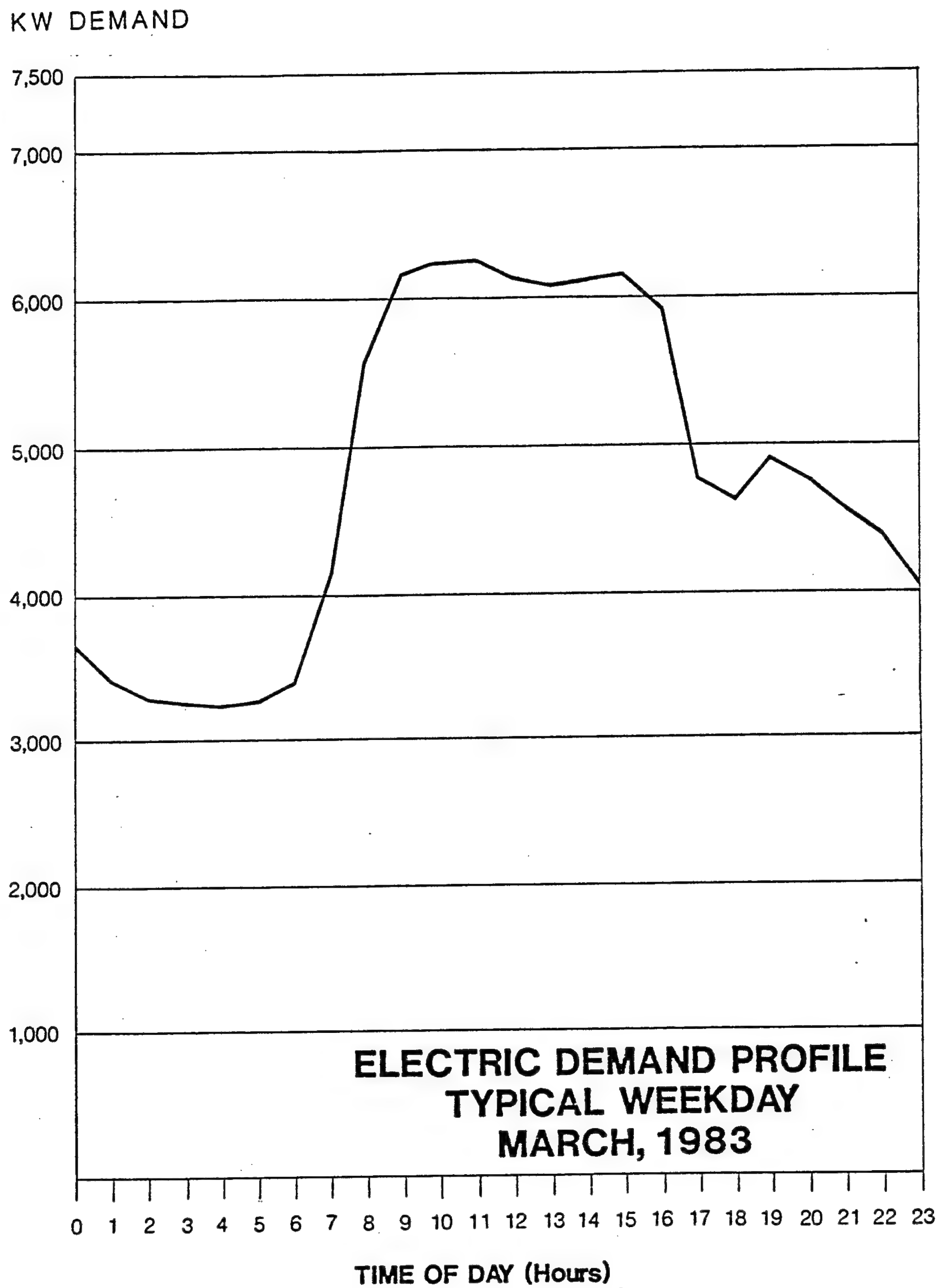

KW DEMAND
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
ELECTRIC
DEMAND
OCT '80
NOV '80
DEC '80
JAN '81
FEB '81
MAR '81
APR '81
MAY '81
JUN '81
JUL '81
AUG '81
SEP '81
FISCAL YEAR '81

FIGURE 2-7


KW DEMAND
7,500
7,000
6,000
5,000
4,000
3,000
2,000
1,000
ELECTRIC DEMAND PROFILE
TYPICAL WEEKDAY
MARCH, 1983
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
TIME OF DAY (Hours)

## 2.3 Energy Costs

Table 2-3 entitled "ENERGY COSTS" lists Base Unit Costs (FY81), MBTU Unit Costs (FY81) and MBTU Unit Costs (FY85) for each individual energy source.

These costs were derived in the following manner:

- o Fuel consumption and costs for FY81 were obtained from base utility records (Note: FY82 cost data was not available and FY81 consumption and costs were used with the appropriate escalation rates).

- o Base Unit Cost for each fuel is the total yearly cost divided by the total yearly consumption.

- o MBTU Unit cost (FY81) for each fuel is based on the following conversion factors:

  1 GAL (No. 2 Fuel Oil) = 0.1387 MBTU
  1 GAL (No. 6 Fuel Oil) = 0.1440 MBTU
  1 CCF (Natural Gas) = 0.1031 MBTU
  1 KWH (Electricity) = 0.0116 MBTU

- o MBTU Unit Cost (FY85) is based on the following annual escalation rates:

  Fuel Oil - 15%
  Natural Gas - 20%
  Electricity - 15%

These escalation rates are taken from Appendix B, Table 2, Page B1 of 6 of the 1980 Norfolk District ECIP Guidance.

TABLE 2-3
ENERGY COSTS

| Energy Source | Base Unit Cost (FY81) | MBTU Unit Cost (FY81) | MBTU Unit Cost (FY85) |
|---|---|---|---|
| No. 2 Fuel Oil | $1.22/Gal | $8.80/MBTU | $15.39/MBTU |
| No. 6 Fuel Oil | $0.87/Gal | $6.04/MBTU | $10.56/MBTU |
| Aug. Oil* | $1.08/Gal | $7.80/MBTU | $13.64/MBTU |
| Natural Gas | $0.454/CCF | $4.40/MBTU | $ 9.12/MBTU |
| Electricity | $0.063/KWH | $5.39/MBTU | $ 9.43/MBTU |

* Weighted average based on FY81 consumption. The ECIP sheet uses this value.

# 3.0 Energy Conservation Measures Developed

## 3.1 Increment A Projects

### 3.1.1 Definition

Increment A projects involve modifying, improving or retrofitting existing buildings. These projects typically involve architectural and structural features, HVAC systems, plumbing systems, interior and exterior building lighting and parking facilities lighting.

### 3.1.2 Potential Energy Conservation Measures

Potential energy conservation measures are based on the list in the Scope of Work Annex A entitlted "ENERGY CONSERVATION OPPORTUNITIES". The energy conservation opportunities (measures) which apply to increment A are listed in Table 3-1 below.

**TABLE 3-1**

POTENTIAL ENERGY CONSERVATION MEASURES - INCREMENT A

- o Insulation
- o Storm windows or double glazing
- o Weatherstripping and caulking
- o Insulated panels
- o Solar films
- o Vestibules
- o Load dock seals
- o Reduction of glass area
- o Replace kitchen light fixtures
- o Shut down energy to hot water heaters or modify controls
- o Energy conserving fluorescent lamps
- o Reduce lighting levels
- o Replace incandescent lighting
- o Use more efficient lighting source
- o High efficiency motor replacement
- o Night setback/setup
- o Infrared heaters
- o Economizer cycles
- o Control hot water circulation pump
- o FM radio controls
- o Radiator controls
- o Decentralize domestic hot water heaters
- o Install shower flow restrictors
- o Heat reclaim from hot refrigerant gas
- o Reduce air flow
- o Prevent air stratification
- o Install time clocks
- o Insulate steam lines
- o Return condensate

### 3.1.3 Recommended Energy Conservation Measures

#### 3.1.3.1 Economic Analysis

Each ECM for each building is analyzed in accordance with the ECIP Life Cycle Cost Economic Analysis Summary. An ECM will be "recommended" for a building under Increment A provided it has a Savings to Investment Ratio of at least 1.0.

#### 3.1.3.2 Numerical Assignment

Each recommended ECM has been assigned a number for reference purposes and is listed in Table 3-2 below. The ECMs were not numbered consecutively for one of two reasons. Either an item from Annex A was not appropriate or an item from Annex A was broken down into two or more ECMs. This was this case with "insulation". Wall and roof insulation were considered separate ECMs.

**TABLE 3-2**

RECOMMENDED ECMs - NUMERICAL ASSIGNMENT

| ECM NO. | DESCRIPTION |
|---|---|
| 1 | Reduce outside air intake |
| 3 | Duty cycling controls |
| 4A | Wall insulation |
| 4B | Roof insulation |
| 5 | Storm windows |
| 6 | Window caulking |
| 7 | Radiator control valves |
| 8A | Replace furnace |
| 12 | Outdoor reset for heating systems |
| 13 | Night setback |
| 17 | Separate domestic hot water from space heating |
| 19 | Insulate domestic hot water storage tank |
| 22 | Insulate steam piping |
| 25 | Install flow restrictors and reduce domestic hot water temperature |
| 29 | Energy saver lighting fixtures |
| 31 | Energy saver lamps |
| 36 | Reduce stratification |
| 43 | Enthalpy economizer |
| 45 | Reduce supply air |
| 50 | Remove radiation |
| 52 | Reduce air volume |
| 54 | Install chillermizer |
| 55 | Add strainer cycle |
| 56 | Supply air temperature reset |
| 57 | Return air recirculation |

#### 3.1.3.3 Brief Description of Recommended ECMs

The following is a brief description of each recommended ECM.

ECM 1. Reduce Outside Air Intake - Lower the percentage of outside air drawn into the central air handling units, with a resultant lowering of heating and cooling loads.

ECM 3. Install Duty Cycling Controls - Automatically stop and start air handling equipment at present intervals to reduce electric consumption and demand charges.

ECM 4A. Wall Insulation - Install wall insulation to lower "U" values and reduce heating and cooling loads.

ECM 4B. Roof Insulation - Install roof insulation to lower "U" values and reduce heating and cooling loads.

ECM 5. Storm Windows - Install storm windows and doors over existing windows and doors to lower "U" factors and limit infiltration thereby reducing heating and cooling loads.

ECM 6. Window Caulking - Provide window caulking to limit infiltration and reduce heating and cooling loads.

ECM 7. Radiator Control Valves - Install thermostatically controlled radiator valves to maintain room temperature and reduce energy usage.

ECM 8A. Replace Furnace - Install new furnace to maintain room conditions with less energy usage.

ECM 12. Outdoor Reset For Heating Systems - Provide automatic reset of heating hot water temperature, proportional to changes in outside air temperature, to reduce piping het losses and to prevent overheating within occupied area.

ECM 13. Night Setback - Automatically lower night heating temperatures and raise night cooling temperatures to reduce heating and cooling loads.

ECM 17. Install Separate Domestic Hot Water Heaters - Isolate domestic hot water production from heating boiler to eliminate boiler use in non-heating seasons.

ECM 19. Insulate Domestic Hot Water Storage Tanks - Lower heat transmission losses from stored hot water to reduce fuel usage.

ECM 22. Insulate Steam Piping - Lower heat transfer losses from steam piping resulting in a reduced heating load.

ECM 25. Install Flow Restrictors and Reduce Domestic Hot Water Temperature - Install flow restrictors in showers, sinks, and lavatories to limit the flow of domestic hot and cold water and reduce hot water temperature to reduce heating energy, water and sewer usage.

ECM 29. Energy Saver Lighting Fixtures - Remove existing standard fixtures and install high efficiency fixtures.

ECM 31. Energy Saver Lamps - Install new high efficiency lamps in existing light fixtures to reduce electric energy usage and cooling loads.

ECM 36. Reduce Stratification - Install recirculating fans in high bay areas to redistribute warm air in the heating season and reduce heating loads.

ECM 43. Enthalpy Economizer - Bring in maximum amount of outside air when the heat content is less than that of the return air to reduce cooling loads.

ECM 45. Reduce Supply Air - Reduce quantity of supply air in certain areas to reduce heating and cooling loads.

ECM 50. Remove Radiation - Remove radiation in certain areas to reduce heating loads.

ECM 52. Reduce Air Volume - Convert existing multizone HVAC unit to single zone and reduce air requirements and lower heating and cooling loads.

ECM 54. Install Chillermizer - Install chilled water reset system to save electric energy and demand.

ECM 55. Add Strainer Cycle - Install a strainer on existing condenser water piping. When the outside temperature drops below a predetermined limit tower water is injected into the circuit. Electric energy is saved as refrigeration machinery and chilled water pumps are by-passed.

ECM 56. Supply Air Temperature Reset - Install a control system to reset the supply discharge air temperature based on the highest zone load to reduce heating and cooling loads.

ECM 57. Return Air Recirculation - During unoccupied hours eliminate outside air and recirculate return air to reduce heating and cooling loads.

### 3.1.4 Energy Conservation Measures Considered But Not Recommended

#### 3.1.4.1 General

Energy conservation measures which were considered but not recommended fall into one of two categories. Either an ECM failed to qualify under ECIP criteria or was not applicable to any of the buildings at Fort Monmouth. If an ECM failed to qualify under ECIP criteria it falls under Increment G.

Projects for Increment G are discussed in Chapter 16 of the Main Reort Volume 1 of 2. A brief discussion of the remaining ECMs which are not applicable to the base follows.

#### 3.1.4.2 Energy Conservation Measures From Annex A Not Applicable For Fort Monmouth

Solar Films - Large areas of glass will be covered by storm windows, double glazing or kalwall under Increments A and G.

Vestibule - Areas which require vestibules already have them.

Load Dock Seals - Major loading docks have seals.

High Efficiency Motor Replacement - No "large" motors on the base.

Infrared Heaters - Field investigation did not yield any promising applications.

FM Radio Controls - Not appropriate for satellite/communications facility such as Fort Monmouth.

Heat Reclaim from Hot reclaim Refrigerant Gas - No "large" chiller plant for heat application.

Install Time Clocks - According to base personnel, time clocks would be impractical due to the large number required and the shortage of staff to maintain them.

#### 3.1.4.3 Detailed Listing of Increment A Projects

There are approximately 2,500 Increment A projects applied to 600 buildings in this study. Such a long list would not be appropriate here. Project Development Brochures for Increment A were prepared for all trades for a group of buildings known as a Sector.

Site maps showing sector locations and building lists for each sector are in the Main Report - Volume 1 of 2, Chapter 3.

### 3.1.5 Summary of Results - Increment A

Increment A work for each sector showing MBTU/YR saved, $/YR saved, CWE-85, SIR, ECR, and SAP (Yrs) is listed in Table 11.3 below.

TABLE 11.3

INCREMENT A - SUMMARY OF RESULTS

| SECTOR | MBTU/YR | $/YR | CWE-85 | SIR | ECR | SAP |
|---|---|---|---|---|---|---|
| 1 | 76,227 | 1,073,671 | 680,964 | 22.9 | 111.9 | 0.6 |
| 2 | 70,850 | 902,791 | 1,776,905 | 7.2 | 39.9 | 2.0 |
| 3 | 40,970 | 525,627 | 846,548 | 8.9 | 48.4 | 1.6 |
| 4-HSG | 27,910 | 338,803 | 453,538 | 10.6 | 61.5 | 1.3 |
| 4-TCT | 31,279 | 368,126 | 490,773 | 10.6 | 63.7 | 1.3 |
| 5 | 23,097 | 298,582 | 644,919 | 6.7 | 35.8 | 2.2 |
| 6-HSG | 39,897 | 489,227 | 1,490,107 | 4.7 | 26.8 | 3.0 |
| Wherry-HSG | 22,062 | 284,260 | 350,134 | 11.8 | 63.0 | 1.2 |
| 6-TCT | 14,791 | 186,195 | 504,172 | 5.3 | 29.3 | 2.7 |
| 7 | 30,718 | 387,181 | 1,014,429 | 5.5 | 30.3 | 2.6 |
| TOTAL/AVG | 377,801 | 4,854,463 | 8,252,499 | 8.3 | 45.8 | 1.7 |

## 3.2 Increment B Projects

### 3.2.1 Definition

Increment B projects involve utilities and energy distribution systems, EMCS for building and distribution systems, and existing energy plants. Energy distribution systems include steam, chilled water and hot water distribution as well as pumps, wells, storage and treatment facilities.

### 3.2.2 Description of Recommended Projects

There are two recommended projects under Increment B. These are installation of an Energy Monitoring and Control System (EMCS) and energy efficient street lighting.

#### 3.2.2.1 EMCS

The detailed feasibility study for the EMCS is contained in the Main Report - Volume 2 of 2 (EMCS). A brief summary of results follows.

1. An Energy Monitoring and Control System (EMCS), consisting of 5,765 input/output points, could be installed in 213 buildings at Fort Monmouth and meet all the requirements of an ECIP project. For purposes of the computer analysis the seven boiler plants serving fifty two buildings in Wherry Housing were counted as one building.

2. The estimated project cost (1985) is $6,675,870. The project would have an annual source energy savings of 350,957 MBTU/YR, an SIR of 6.5, an ECR of 52.6 and a SAP of 1.7 years.

3. Using FY81 as a base year, fossil fuel consumption will be reduced by 20% and electricity consumption will be reduced by 32%.

4. Government-owned telephone lines within and between each subpost could provide the necessary EMCS communications links.

5. A 1,000 square foot building to be constructed adjacent to Facilities Engineering (Building 167) will provide a suitable location for the Master Control Room.

6. The Master Control Room shall be open only to selected personnel.

7. The effectiveness of the EMCS installation will be greatly reduced without support from all appropriate agencies and commands.

8. Base personnel should discuss and determine the organizational location of the EMCS Operator/Manager and established appropriate communication channels.

9. Monitoring the run time of HVAC equipment could be performed by the EMCS to assist maintenance personnel.

10. FM radio control for Military Family Housing would be unsuitable on a satellite communications facility such as Fort Monmouth.

### 3.2.2.2 Street Lighting

This project proposes to reduce energy consumption through the installation of energy saving light fixtures. These fixtures will be installed in the following locations: Basewide on Main Post except for nineteen fixtures in the residential area currently being renovated, basewide on the Charles Wood Area including the parking area next to Bldg 2704 and basewide on the Evans Area.

## 3.2.3 Increment B - Projects Considered But Not Recommended

### 3.2.3.1 Power Factor Correction

The electric bills at Fort Monmouth are divided into the areas of the Main Post, Charles Wood, and Evans. The final costs and savings for Power Factor Correction were computed combining the data of all three areas and an ECIP Life Cycle Cost Economic Analysis was performed (see Appendix - Volume 4, Section 10 for back-up calculations).

The power factors averaged out for the fiscal year 1982 were 84% for the Main Post, 79% for Charles Wood, and 72% for Evans. The calculations were made based on a power factor correction of 90% and 95%.

If the power factor for the entire base was corrected to 95%, a savings of $6,889 (FY83) would result due to the decrease in KVA demand. 4,130 KVAR of capacitors would be required. The cost for the installation of the capacitors would be $419,647 and it would save 1,734 MBTU/YR due to the decrease in I.I.R. losses in the line.

If the correction was made to 90% a savings of $4,655 (FY83) would result due to the decrease in KVA demand. 2,478 KVAR of capacitors would be required. This would result in a savings of 1,188 MBTU/YR (I.I.R. losses) and, according to a manufacturer, would cost the same as the correction to 95% power factor.

The power distribution system at Fort Monmouth contains long transmission lines leading to transformers located at each building. At the primary side of the transformer the voltage is 4160V and this voltage is stepped down to 240V/120V or 120V/208V on the secondary side. By placing the power capacitors on the secondary side of every transformer the losses in the transmission lines and the transformers would be reduced in the following manner: The lagging reactive components introduced by the capacitors will act towards cancelling the leading reactive components of the transformers and motors. This in turn will decrease the total current and therefore the I.I.R. losses of the system.

The reduction in I.I.R. losses in the system is calculated to be 26.7% and 18.3% by correcting the power factor to 95% and 90% respectively. This is a percentage of the line losses already present in the power system which have been calculated to be approximately 1% of the KW demand.

The calculation for the percentage of losses in the line was made for the case of 100% rated load. This is justified by the following: The I.I.R. losses of the system vary directly with the square of the current and inversely with the square of the power factor. As the current is decreased, the power factor will decrease also. However, the power factor decrease occurs at a slower rate than the current decrease. Therefore the maximum percent line losses still occur at higher loads. If the power factor correction is not justified at maximum load, the savings in the line losses at less than full load would be even lower. In our case the line losses on two feeders were calculated. A conservative value of 1% was used although in both cases the line losses were below 1% of power consumed by the base.

The energy savings from power factor correction is not usually the major savings to the electricity user. The major savings usually results from the decrease in the KVA demand charge, but, in the case of Fort Monmouth, this charge is very small ($0.30 per extra KVA demand based on power factor less than unity). Fort Monmouth is charged for KW demand. This value will decrease only slightly due to the percent decrease in line

losses which were shown to be only a small value of the KW demand of the base. This leads to a low Savings-to-Investment Ratio (SIR) of 0.6 and 0.4 for 95% and 90% power factor correction respectively. This project does not qualify under ECIP criteria since the SIR in both cases (95% and 90% power factor correction) is below 1.0.

In addition to the above consideration an additional factor should be considered. It can be noted that poor power factors occur at Evans and Charles Wood. At these posts most transformers are operated below their nameplate ratings. At lower loads transformer inductance becomes more significant and acts toward lowering the system power factor. Corrective capacitors introduced at these bases could ultimately cause an overall leading power factor if the transformers were ever loaded close to their full capacity. A leading power factor thus introduced will have the same undesirable consequences as a lagging power factor such as an increase in the line losses. This is an additional reason for not recommending power factor correction at this time.

### 3.2.4 Summary of Results - Increment B

Increment B projects showing MBTU/YR saved, $/YR saved, CWE-85, SIR, ECR and SAP (Yrs) are listed in Table 3-4, below.

TABLE 3-4

INCREMENT B - SUMMARY OF RESULTS

| PROJECT | MBTU/YR | $/YR | CWE-85 | SIR | ECR | SAP |
|---|---|---|---|---|---|---|
| EMCS | 350,957 | 3,836,319 | 6,675,870 | 6.5 | 52.6 | 1.7 |
| Street Lighting | 8,362 | 78,853 | 410,813 | 2.1 | 20.4 | 5.2 |
| TOTAL/AVG | 359,319 | 3,915,172 | 7,086,683 | 5.3 | 50.7 | 1.8 |

## 3.3 Increment G

### 3.3.1 Definition

Increment G projects are those feasible energy savings projects developed in Increments A and B which do not qualify under ECIP criteria.

### 3.3.2 Summary of Results

Increment G work will save 11,056 MBTU/YR with a construction cost of approximately $3.3 million resulting in an ECR of 3.4 and an SIR of 0.4.

## 4.0 Energy and Cost Savings

### 4.1 Predicted Energy Savings from Recommended Projects

Predicted energy savings from recommended projects, in MBTU/YR, are listed below in Table 4-1 for electricity, fuel oil (No. 2 and No. 6 combined), natural gas and source energy.

TABLE 4-1

MBTU/YR ENERGY SAVINGS FROM RECOMMENDED PROJECTS

| PROJECT | ELECTRIC | FUEL OIL | NAT. GAS | SOURCE ENERGY |
|---|---|---|---|---|
| Sector 1 | 4,062 | 71,423 | 742 | 76,227 |
| Sector 2 | 9,616 | 55,090 | 6,144 | 70,850 |
| Sector 3 | 2,233 | 34,034 | 4,703 | 40,970 |
| Sector 4H | 2,691 | 19,267 | 5,952 | 27,910 |
| Sector 4T | 2,689 | 18,881 | 9,709 | 31,279 |
| Sector 5 | 725 | 20,249 | 2,123 | 23,097 |
| Sector 6H | 686 | 28,916 | 10,295 | 39,897 |
| Sector 6T | 1,437 | 11,740 | 1,614 | 14,791 |
| Wherry | 0 | 19,195 | 2,867 | 22,062 |
| Sector 7 | 1,544 | 24,650 | 4,524 | 30,718 |
| EMCS | 202,564 | 126,725 | 21,668 | 350,957 |
| Boiler Decent. | 0 | 15,085 | 0 | 15,085 |
| Street Light | 8,362 | 0 | 0 | 8,362 |
| Geothermal | -676 | 832 | 0 | 156 |
| Incr. G. | 1,736 | 8,540 | 1,180 | 11,456 |
| TOTALS | 237,669 | 454,627 | 71,521 | 763,817 |

### 4.2 Energy Savings - Percent Reduction from Base Year FY75

Percent reduction for each individual energy source and total source energy are listed in Table 4-2 below.

TABLE 4-2

ENERGY SAVINGS PERCENT REDUCTION FROM BASE YEAR FY75

| FUEL | FY75 - MBTU/YR | SAVINGS - MBTU/YR | % REDUCTION |
|---|---|---|---|
| Elec. | 823,616 | 237,669 | 29 |
| Oil | 921,563 | 454,627 | 49 |
| Gas | 139,201 | 71,521 | 51 |
| Source | 1,884,380 | 763,817 | 41 |

## 4.3 Anticipated Monetary Savings and Construction Costs

Annual dollar savings and construction costs for each of the recommended projects is listed in Table 4-3, below.

TABLE 4-3

ANNUAL DOLLAR SAVINGS AND CONSTRUCTION COSTS

| PROJECT | $/YR SAVED | CWE-85 |
|---|---|---|
| Sector 1 | 1,073,671 | 680,964 |
| Sector 2 | 902,791 | 1,776,905 |
| Sector 3 | 525,627 | 846,548 |
| Sector 4H | 338,803 | 453,538 |
| Sector 4T | 368,126 | 490,773 |
| Sector 5 | 298,582 | 644,919 |
| Sector 6H | 489,227 | 1,490,107 |
| Sector 6T | 186,195 | 504,172 |
| Wherry | 284,260 | 350,134 |
| Sector 7 | 387,161 | 1,014,439 |
| EMCS | 3,836,319 | 6,675,870 |
| Boiler Decent. | 205,759 | 1,696,539 |
| Street Lighting | 78,853 | 410,813 |
| Geothermal | 4,973 | 59,794 |
| Incr. G | 141,923 | 3,316,446 |
| | 9,122,270 | 20,411,961 |

The simple amortization period for the above projects is (20,411,961/9,122,270) = 2.2 years.

## 5.0 Solar and Renewable Energy

### 5.1 Scope

Solar and renewable energy fall under Increment C. Work under Increment C involves renewable energy projects, principally solar and biomass. The analysis involves determining the feasibility of utilizing solar and biomass for space heating, space coolng, domestic hot water or process heat or combinations thereof.

Increment C is not a part of this Energy Engineering Analysis. However, the work in this Chapter was uncovered during the Increment A portion of the study.

### 5.2 Recommended Projects

The two recommended projects in this Chapter are solar heating of the pool in Bldg 114 and geothermal heating in Bldg 689.

#### 5.2.1 Solar Heating of Pool

A 200,000 gallon pool in the Field House (Bldg 114) has a water temperature of 81° to 82°F. The fill water is preheated to 85°$\pm$ 2°F. The air in the pool is kept at 78°-84°F depending on the outside temperature. 4000 square feet of solar panels can absorb 1200 BTU/SQ. FT. - DAY resulting in 1051 MBTU/YR of "pool-heating" energy.

#### 5.2.2 Geothermal Energy

This project proposes to reduce energy consumption by utilizing the low grade heat from well water, available in the facility, to heat the building through the use of a water source heat pump. During the summer season, this same well water acts as a heat sink, eliminating the need for an air-cooled condensing unit.

### 5.3 Summary of Results

Solar and renewable (geothermal) energy projects showing MBTU/YR saved, $/YR saved, CWE-85, SIR, ECR and SAP (Yrs) are listed in Table 5-1, below. Back-up calculations for these projects are in the Appendix - Volume 4, Section 10.

TABLE 5-1

SOLAR AND RENEWABLE ENERGY - SUMMARY OF RESULTS

| PROJECT | MBTU/YR | $/YR | CWE-85 | SIR | ECR | SAP |
|---|---|---|---|---|---|---|
| Solar | 1051 | 13,716 | 96,888 | 2.1 | 10.8 | 7.1 |
| Geothermal | 156 | 4,973 | 59,794 | 1.6 | 2.6 | 12.0 |
| TOTAL/AVG | 1207 | 18,689 | 156,682 | 1.9 | 7.7 | 8.4 |

## 6.0 Increment D

### 6.1 Scope

Increment D projects involve determining the feasibility of new cogeneration and solid waste plants utilizing solid fuels supplemented, if feasible, with refuse derived fuels (RDF) and waste oil fuels. The primary objective is to reduce energy consumption through the capture and reuse of energy presently being wasted.

### 6.2 Types of Systems Investigated

There are no sources of waste oil available at the site, therefore this report will study only the use of refuse derived fuel.

The types of systems investigated were:

- Mass Burning
- Multiple Hearth Furnaces
- Fluidized Bed Furnaces
- Modified Solid Fuel Furnaces

Of these systems, only the modified solid fuel furnaces would be applicable for Fort Monmouth.

#### 6.2.1 Types of Modified Solid Fuel Furnaces

The following types of modified solid fuel furnaces were investigated:

- Water Wall Furnace
- Water-Cooled Rotary Combustor
- Modular Comustor Unit
- Semi-Suspended Furnace

Of these systems, only the semi-suspended is applicable for Fort Monmouth.

### 6.3 Results and Recommendations

The results of the analysis indicate a net life-cycle cost increase of approximately $60 million (1985). Therefore, conversion of oil-fired boiler plants to RDF is not recommended.

## 7.0 Increment E

### 7.1 Scope

Increment E projects involve determining the feasibility of constructing central boiler plants to supply steam or high temperature hot water, as applicable, to all or discrete parts of the base.

### 7.2 Projects Investigated

The following projects were investigated under this Increment:

- o Feasibility of a new oil-fired central plant with steam distribution for the entire main post.
- o Conversion to coal firing of both plants with no change in distribution
- o conversion to coal firing with extension of distribution system of each plant to selected near-by buildings to optimize use of both plants and eliminate some individual heating plants
- o retention of oil as fuel but to interconnect both plants to optimize fuel and labor efficiencies
- o retention of oil as fuel but with extension of distribution of each plant to selected near-by buildings to optimize use of both plants and eliminate some individual heating plants
- o construction of one new coal fired central plant with new distribution system to serve the entire main base
- o construction of one new central plant fired by refuse derived fuel (RDF) with new distribution system to serve entire main base
- o addition of energy monitoring and control system (EMCS) to the existing boiler plants
- o decentralization of boiler plant 1220

### 7.3 Recommended Projects

The only recommended project under this Increment is boiler decentralization for Building 1220.

This project proposes to reduce energy consumption through the elimination of the central high pressure steam boiler plant and its underground steam distribution system. In place of the central boiler plant, individual low pressure steam boilers will be installed in each of 14 buildings. In addition to the annual energy savings from reduced energy consumption and distribution losses, this conversion from a central plant to individual plants will also include savings due to lower maintenance and operating requirements.

### 7.3.1 ECIP Analysis

| | |
|---|---|
| CWE-85 | $1,696,539 |
| Annual Energy Savings | 15,085 MBTU/YR |
| Annual Dollar Savings | $355,759/YR |
| ECR | 8.9 |
| SIR | 2.6 |
| SAP | 4.8 YRS |

## 8.0 Energy Plan

### 8.1 Summary of Results

1. With the implementation of the recommended projects outlined in this report, source energy consumption per unit area will be reduced by 32% (from 259 to 175 KBTU/GSF-YR) compared with the base year FY75. This exceeds the DARCOM Goal of 20%. In other words, the DARCOM Goal will be met.

2. Using a base year of FY75, there will be the following reduction in overall energy use:

   o Electricity - 29%
   o Fuel Oil - 49%
   o Natural Gas - 51%
   o Total Energy Source - 41%

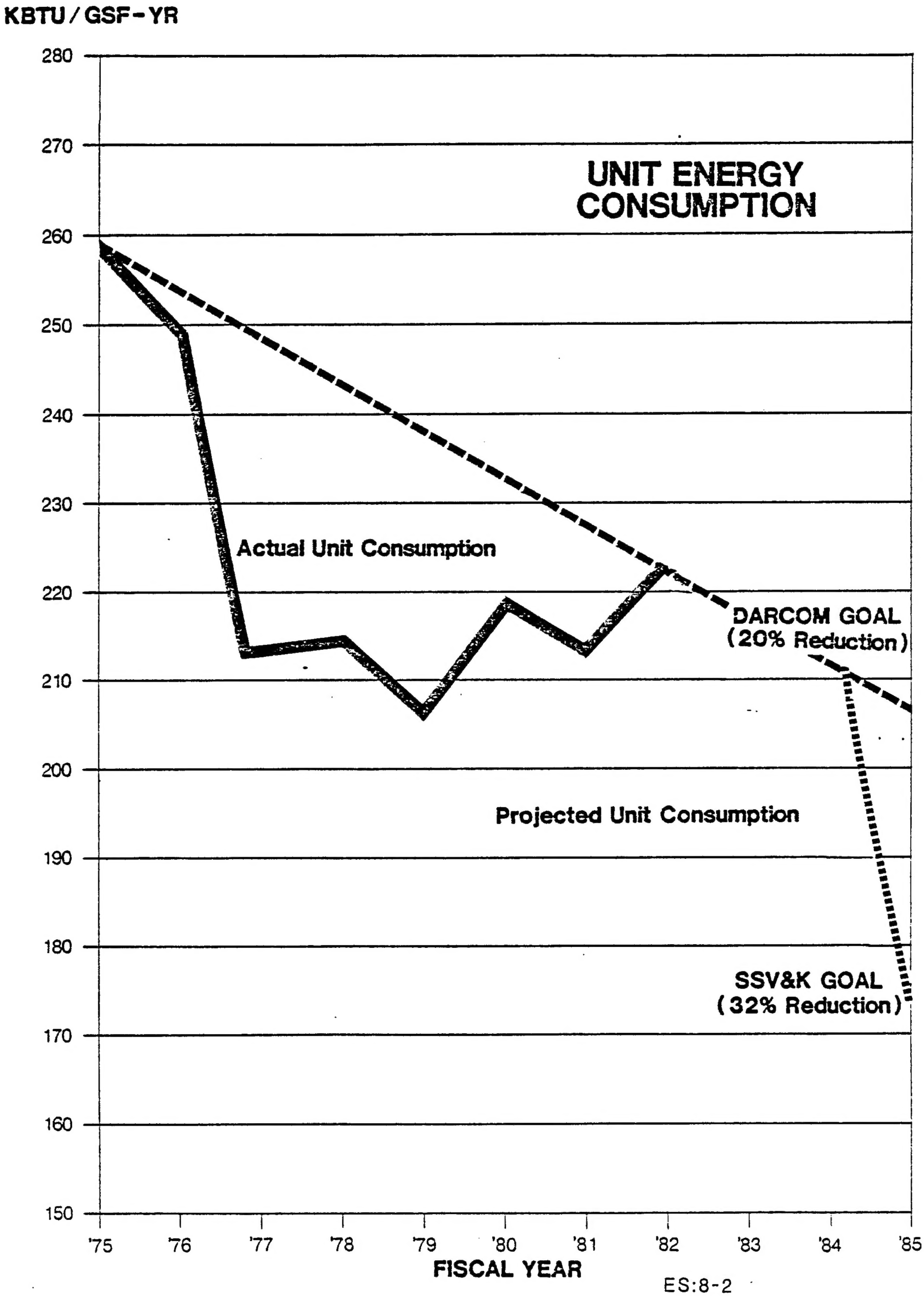
3. The recommended ECIP projects from this analysis will result in an annual dollar savings of approximately $9,122,000, a construction cost of approximately $20,411,000 and will have a simple amortization period of 2.2 years.

### 8.2 Unit Energy Consumption and the DARCOM Goal

Figure 8-1, on the following page, lists actual unit consumption (KBTU/GSF-YR) from FY75 through FY82 and projected unit consumption from FY83 through FY85. The DARCOM goal is represented by a straight line from FY75 through FY85 showing a 2% reduction per year over a ten year period (an overall reduction of 20%).

The savings resulting from the $20,000,000 investment will start in mid FY84 and will generally be completed by the end of FY85.

FIGURE 8-1


KBTU / GSF-YR
280
270
260
250
240
230
220
210
200
190
180
170
160
150
UNIT ENERGY CONSUMPTION
Actual Unit Consumption
DARCOM GOAL (20% Reduction)
Projected Unit Consumption
SSV&K GOAL (32% Reduction)
'75
'76
'77
'78
'79
'80
'81
'82
'83
'84
'85
FISCAL YEAR

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